3|p.t>

10/520527
JT12 Rec'd PCT/PTO 07 JAN 2005

Translation of description of WO 2004/007783

COPPER ALLOY, PARTICULARLY FOR GLASSES FRAMES

ALLOY, PARTICULARLY FOR GLASSES FRAMES

The present invention relates to an alloy, particularly for glasses frames, jewelry, and for other metal parts which are to be worn on the body and/or which are attached to pieces of clothing and come into contact with the body. Furthermore, the present invention relates to glasses frames, jewelry, and metal parts for pieces of clothing which are manufactured using the alloy, as well as intermediate products and precursor materials, particularly a wire, strip, or rod material, manufactured using an alloy of this type.

In the manufacturing of glasses frames, jewelry, metal parts to be worn on the body, or other metal parts which may come into contact with the body, particular criteria relating to the suitability of these metal parts apply. Thus, for example, particularly for glasses frames, which are at least partially in continuous contact with the skin of the person wearing the glasses, it has been shown to be desirable for avoiding contact allergies, which have become widespread, for the wire to be used for manufacturing the glasses frames to comprise a nickel-free alloy. However, a nickel-free wire used for manufacturing glasses frames must also meet the mechanical requirements which are placed on glasses frames, as do conventional alloy wires containing nickel, such as wires made of German silver alloys. A wire made of a nickel-free alloy must also have an at least comparable deformability, in order to allow cost-effective manufacturing of the glasses frames.

An alloy is already known from DE 100 43 278 A1, which fulfills the requirement profile above and particularly also still has a hardness meeting the requirements for glasses frames in a deformation range greater than 70 %.

The present invention is based on the object of suggesting a nickel-free, well-deformable alloy which has deformability improved even further in relation to the known alloys, particularly those used in the manufacturing of glasses frames, and generally improved ability to

be processed and therefore allows even more cost-effective manufacturing of corresponding metal parts, particularly glasses frames.

This object is achieved by an alloy having the features of Claim 1.

The nickel-free alloy according to the present invention has, besides good deformability with a degree of deformation which may be greater than 80 %, good solderability and good cutting, stamping, and embossing properties. The good solderability is achieved in particular in that the alloy according to the present invention allows a soldering procedure without using flux, because of its alloy composition. In this case, the application of an inductive soldering method using inert gas has proven especially advantageous.

The good cutting, stamping, and embossing properties of the alloy according to the present invention are to be attributed to the special ductility of the alloy material, which allows, for example, cutting of material edges without a large fracture component, so that cut edges are essentially formed through shearing. Therefore, clean cut edges may be produced in a simple way, so that they require only a little polishing for the subsequent processing.

In spite of the good deformability, the alloy material according to the present invention has sufficient hardness to be able to be polished well.

Overall, material properties thus result in the alloy according to the present invention which are comparable to those of German silver alloys, so that processing of corresponding alloy materials, particularly a corresponding alloy wire, is possible on conventional machines using the tools known from the processing of German silver alloys, without essential machine parameters having to be changed. This has an advantageous effect on the cost-effective manufacturing of corresponding products.

A special advantage of the alloy according to the present invention is also that, in spite of the above-mentioned positive processing proper-

ties, a spring behavior is achievable in a wire manufactured using the alloy according to the present invention which allows the manufacturing of glasses frames having good resilience properties and therefore good everyday capability.

The composition according to Claim 2 has an especially advantageous exemplary embodiment of the alloy.

If the alloy according to the present invention is used as a material for glasses frames, the above-mentioned advantages achievable using the material may be exploited to an especially large extent. This is also comparably true for jewelry or metal parts for pieces of clothing which are manufactured using the alloy according to the present invention, particularly implemented in the form of wires or strips or even as rod material.

In the following, exemplary embodiments of the alloy are described in greater detail with reference to the drawing.

Figure 1 shows a hardness-deformation diagram with a comparative illustration of the hardness curve of an exemplary embodiment of the alloy in comparison to a German silver alloy having 18% nickel;

Figure 2a shows a strength/hardness-deformation diagram relating to the above-mentioned alloy;

Figure 2b shows a value table relating to the diagram shown in Figure 2a;

Figure 3a shows a strength/hardness-temperature diagram relating to the above-mentioned alloy;

Figure 3b shows a value table relating to the diagram in Figure 3a.

In Figure 1, the hardness curve identified with E shows an exemplary embodiment of the wire alloy which is referred to the following as

CuSn12Zn2. The alloy CuSn12Zn2 has 12 % Sn, 2.1 % Zn, 0.008 % Mn, 0.002 % P, 0.003 % Fe, and the remainder copper. The graph identified with S illustrates the hardness curve of a German silver alloy having 18 % nickel as a comparison.

As the comparison shows, the alloy E has a greater hardness over the entire deformation range, which exceeds 80 %.

In Figure 2a, the hardness increase of the CuSn12Zn2 alloy is shown as a function of the deformation, the value table shown in Figure 2b, which is used as the basis, also having the particular cross-sectional reduction [QV] and the particular ductility at a given diameter in addition to the wire diameter achieved in the course of the deformation and the values of strength and hardness shown in Figure 2a.

In Figure 3a, the recrystallization is shown, with the values of strength and hardness over the temperature curve resulting therefrom. The value table shown in Figure 3b, which Figure 3a is based on, has the ductility of the alloy material resulting because of the recrystallization in addition the wire diameter of the alloy wire CuSn12Zn2 and the values of strength and hardness shown in Figure 3a.

In the following, a possibility for manufacturing a wire made of the alloy CuSn12Zn2, which is especially suitable for manufacturing glasses frames, is explained briefly.

First, the alloy CuSn12Zn2 is manufactured from the above-mentioned alloy components through melting at temperatures from 900 °C to 1000 °C. A semifinished product for further processing to manufacture wire is provided by the immediately following continuous casting of strand product having a strand diameter of 12 mm to 14 mm or, for example, even having a diameter of 65 mm to 85 mm, which is reduced to the above-mentioned strand diameter of 12 mm to 14 mm through subsequent extrusion. In the course of a step-by-step diameter reduction through cold rolling, a reduction to a diameter of 8 mm, for example, occurs. The wire blank thus manufactured is subsequently subjected to an annealing treatment under inert gas atmosphere at temperatures from

500 °C to 800 °C over an annealing time from one-half hour to five hours. Subsequently, a further diameter reduction is performed in multiple steps by drawing down to the desired final diameter of the wire of, for example, 2.5 mm, possibly with intermediate annealing between selected diameter reduction steps.

Finally, a surface treatment, e.g., by pickling the wire, particularly to remove any possible oxide coatings, may be performed.

The alloy CuSn12Zn2, which is especially suitable for manufacturing glasses frames, has a Vickers hardness (HV_{10}) of approximately 100 HV_{10} in the soft-annealed state, which rises with increasing deformation. At a degree of deformation of 80 %, the Vickers hardness is at least approximately 280 HV_{10}. This means that the hardness may be approximately tripled through the deformation.

In the soft-annealed state, the tensile strength is 430 N/mm^2 to 450 N/mm^2 and rises with increasing deformation up to values between 1100 N/mm^2 and 1150 N/mm^2 (Figure 2a).

In addition to the alloy CuSn12Zn2 described above, the alloy CuSn12Zn4, which has 2 % more zinc and 2 % less copper while otherwise having the same composition as the first alloy cited, has been shown to be especially suitable for manufacturing glasses frames. The elevated proportion of zinc with a correspondingly reduced proportion of copper has a positive effect on the spring properties of the wire, for example.

As in the case of the alloy CuSn12Zn2, it is possible to bond metal parts made of CuSn12Zn4 to one another using resistance welding. In addition, both above-mentioned alloys are suitable for being coated using the conventional coating methods used in the optical industry.